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Cardiac Arrest and its Causes

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ABSTRACT

Sudden cardiac arrest is the sudden, unexpected loss of heart function, breathing and consciousness. Sudden cardiac arrest usually results from an electrical disturbance in your heart that disrupts its pumping action, stopping blood flow to the rest of your body. Sudden cardiac arrest is different from a heart attack, which occurs when blood flow to a portion of the heart is blocked. However, a heart attack can sometimes trigger an electrical disturbance that leads to sudden cardiac arrest. Sudden cardiac arrest is a medical emergency. If not treated immediately, it causes sudden cardiac death. With fast, appropriate medical care, survival is possible. Administering cardiopulmonary resuscitation (CPR) — or even just compressions to the chest — can improve the chances of survival until emergency personnel arrive.

1. INTRODUCTION

The first cardiac arrest was discovered in March 22nd of 1956. A cardiac arrest**,** also known as cardiopulmonary arrest or circulatory arrest, is the abrupt cessation of normal circulation of the blood due to failure of the heart to contract effectively during systole. A cardiac arrest is different from (but may be caused by) a heart attack (myocardial infarction), where blood flow to the still-beating heart is interrupted (as in cardiogenic shock). Arrested blood circulation prevents delivery of oxygen to ''all'' parts of the body. Cerebral hypoxia, or lack of oxygen supply to the brain, causes victims to lose consciousness and to stop normal breathing, although agonal breathing may still occur. Brain injury is likely if cardiac arrest is untreated for more than five minutes, although new treatments such as induced hypothermia have begun to extend this time. To improve survival and neurological recovery immediate response is paramount.

Cardiac arrest is a medical emergency that, in certain groups of patients, is potentially reversible if treated early enough. When unexpected cardiac arrest leads to death this is called sudden cardiac death (SCD). However, due to inadequate circulation cerebral perfusion, the patient will be unconscious and will have stopped breathing. The main diagnostic criterion to diagnose a cardiac arrest (as opposed to respiratory arrest, which shares many of the same features) is lack of circulation, however there are a number of ways of determining this. In many cases lack of carotid pulse is the gold standard for diagnosing cardiac arrest, but lack of a pulse (particularly in the peripheral pulses) may be a result of other conditions (e.g. shock), or simply an error on the part of the rescuer. Studies have shown that rescuers often make a mistake when checking the carotid pulse in an emergency, whether they are healthcare professionals or lay persons. Owing to the inaccuracy in this method of diagnosis, some bodies such as the European Resuscitation Council (ERC) have de-emphasized its importance. The Resuscitation Council (UK), in line with the ERC's recommendations and those of the American Heart Association, have suggested that the

technique should be used only by healthcare professionals with specific training and expertise, and even then that it should be viewed in conjunction with other indicators such as agonal respiration.

Various other methods for detecting Circulatory system circulation have been proposed. Guidelines following the 2000 International Liaison Committee on Resuscitation (ILCOR) recommendations were for rescuers to look for "signs of Circulatory system circulation", but not specifically the pulse However, in face of evidence that these guidelines were ineffective, the current recommendation of ILCOR is that cardiac arrest should be diagnosed in all casualties who are unconscious and not breathing normally. At autopsy 30% of victims show signs of recent myocardial infarction. Other cardiac conditions potentially leading to arrest include structural abnormalities, arrhythmias and cardiomyopathies. Non-cardiac causes include infections, overdoses, trauma and cancer, in addition to many others.

2. REVERSIBLE CAUSES

Cardiopulmonary resuscitation (CPR), including adjunctive measures such as defibrillation, intubation and drug administration, is the standard of care for initial treatment of cardiac arrest. However, most cardiac arrests occur for a reason, and unless that reason can be found and overcome, CPR is often ineffective, or if it does result in a return of spontaneous Circulatory system circulation, this is short lived.

2.1. Hypovolemia

A lack of circulating body fluids, principally blood volume. This is usually (though not exclusively) caused by some form of bleeding, anaphylaxis, or pregnancy with gravid uterus. Peri-arrest treatment includes giving IV fluids and blood transfusions, and controlling the source of any bleeding - by direct pressure for external bleeding, or emergency surgical techniques such as esophageal banding, gastro esophageal balloon tamponade (for treatment of massive GI bleeding such as in esophageal varices), thoracotomy in cases of penetrating trauma or significant shear forces applied to the chest, or exploratory laparotomy in cases of penetrating trauma, spontaneous rupture of major blood vessels, or rupture of a hollow viscus in the abdomen.

2.2. Hypoxia

A lack of oxygen delivery to the heart, brain and other vital organs. Rapid assessment of airway patency and respiratory effort must be performed. If the patient is mechanically ventilated, the presence of breath sounds and the proper placement of the endotracheal tube should be verified. Treatment may include providing oxygen, proper ventilation, and good CPR technique. In cases of carbon monoxide poisoning or cyanide poisoning, hyperbaric oxygen may be employed after the patient is stabilized.

2.3. Hydrogen ions (Acidosis)

An abnormal pH in the body as a result of lactic acidosis which occurs in prolonged hypoxia and in severe infection, diabetic ketoacidosis, renal failure causing uremia, or ingestion of toxic agents or overdose of pharmacological agents, such as aspirin and other salicylates, ethanol, ethylene glycol and other alcohols, tricyclic antidepressants, isoniazid, or iron sulfate. This can be treated with proper ventilation, good CPR technique, buffers like sodium bicarbonate, and in select cases may require emergent hemodialysis.

2.4. Hyperkalemia or Hypokalemia

Both excess and inadequate potassium can be life-threatening. A common presentation of hyperkalemia is in the patient with end-stage renal disease who has missed a dialysis appointment and presents with weakness, nausea, and broad QRS complexes on the electrocardiogram. (Note however that patients with chronic kidney disease are often more tolerant of high potassium levels as their body often adapts to it.) The electrocardiogram will show tall, peaked T waves (often larger than the R wave) or can degenerate into a sine wave as the QRS complex widens. Immediate initial therapy is the administration of calcium, either as calcium gluconate or calcium chloride. This stabilizes the electrochemical potential of cardiac myocytes, thereby preventing the development of fatal arrhythmias. This is, however, only a temporizing measure. Other temporizing measures may include nebulized albuterol, intravenous insulin (usually given in combination with glucose, and sodium bicarbonate, which all temporarily drive potassium into the interior of cells. Definitive treatment of hyperkalemia requires actual excretion of potassium, either through urine (which can be facilitated by administration of loop diuretics such as furosemide) or in the stool (which is accomplished by giving sodium polystyrene sulfonate enterally, where it will bind potassium in the GI tract.) Severe cases will require emergent hemodialysis. The diagnosis of hypokalemia (not enough potassium) can be suspected when there is a history of diarrhoea or malnutrition. Loop diuretics may also contribute. The electrocardiogram may show flattening of T waves and prominent U waves. Hypokalemia is an important cause of acquired long QT syndrome, and may predispose the patient to torsades de pointes. Digitalis use may increase the risk that hypokalemia will produce life threatening arrhythmias. Hypokalemia is especially dangerous in patients with ischemic heart disease.

2.5. Hypothermia

A low core body temperature, defined clinically as a temperature of less than 35 degrees Celsius (95 degrees Fahrenheit). The patient is re-warmed either by using a cardiac bypass or by irrigation of the body cavities (such as thorax, peritoneum, and bladder) with warm fluids; or warmed IV fluids. CPR only is given until the core body temperature reached 30 degrees Celsius, as defibrillation is ineffective at lower temperatures. Patients have been known to be successfully resuscitated after periods of hours in hypothermia and cardiac arrest, and this has given rise to the often-quoted medical truism, "You're not dead until you're warm and dead."

2.6. Hypoglycemia or Hyperglycemia

Low blood glucose from overdose of oral hypoglycemics such as sulfonylureas, or overdose of insulin. Rare endocrine disorders can also cause unexpected hypoglycemia. Generally, hyperglycemia is itself not fatal, however DKA will cause pH to drop, and nonketotic hyperosmolar coma leads to a severely hypovolemic state. Hypoglycemia is corrected rapidly by intravenous administration of concentrated glucose (typically 25 ml of 50% glucose in adults, but in children 25% glucose is used, and in neonates 10% glucose is used.) However, the patient will often require a continuous intravenous drip until the causative agent is completely metabolized. In DKA, the goal is correction of acidosis. In NKH, the goal is adequate fluid resuscitation.

2.7. Tablets or Toxins

Tricyclic antidepressants, phenothiazines, beta blockers, calcium channel blockers, cocaine, digoxin, aspirin, acetominophen. This may be evidenced by items found on or around the patient, the patient's medical history (i.e. drug abuse, medication) taken from family and friends, checking the medical records to make sure no interacting drugs were prescribed, or sending blood and urine samples to the toxicology lab for report. Treatment may include specific antidotes, fluids for volume expansion, vasopressors, sodium bicarbonate (for tricyclic antidepressants), glucagon or calcium (for calcium channel blockers), benzodiazepines (for cocaine), or cardiopulmonary bypass. Herbal supplements and over-the-counter medications should also be considered.

2.8. Cardiac Tamponade

Blood or other fluids building up in the pericardium can put pressure on the heart so that it is not able to beat. This condition can be recognized by the presence of a narrowing pulse pressure, muffled heart sounds, distended neck veins, electrical alternans on the electrocardiogram, or by visualization on echocardiogram. This is treated in an emergency by inserting a needle into the pericardium to drain the fluid (pericardiocentesis), or if the fluid is too thick then a subxiphoid window is performed to cut the pericardium and release the fluid.

2.9. Tension pneumothorax

The build-up of air into one of the pleural cavities, which causes a mediastinal shift. When this happens, the great vessels (particularly the superior vena cava) become kinked, which limits blood return to the heart. The condition can be recognized by severe air hunger, hypoxia, jugular venous distension, hyperressonance to percussion on the effected side, and a tracheal shift away from the effected side. The tracheal shift often requires a chest x-ray to appreciate (although treatment should be initiated prior to obtaining a chest x-ray if this condition is suspected). This is relieved in by a needle thoracotomy (inserting a needle catheter) into the 2nd intercostal space at the mid-clavicular line, which relieves the pressure in the pleural cavity.

2.10. Thrombosis (Myocardial infarction)

If the patient can be successfully resuscitated, there is a chance that the myocardial infarction can be treated, either with thrombolytic therapy or percutaneous coronary intervention.Thromboembolism (Pulmonary embolism) - hemodynamically significant pulmonary emboli are generally massive and typically fatal. Administration of thrombolytics can be attempted, and some specialized centers may perform thrombolectomy, however, prognosis is generally poor.

3. CONCLUSION

In conclusion, sudden cardiac death is a major cause of mortality in Singapore and the rest of the world but this silent killer may be preventable to a certain extent. Primary prevention and early identification and treatment of CAD and heart failure still remain very important. Implantation of an ICD is useful for SCD survivor or for patients who are at a high risk of SCD. However, not all patients who survive a SCD attack would require an ICD, especially after a heart attack.

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